EE2801
Assignment 3

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1 Input signal - $x[n]$

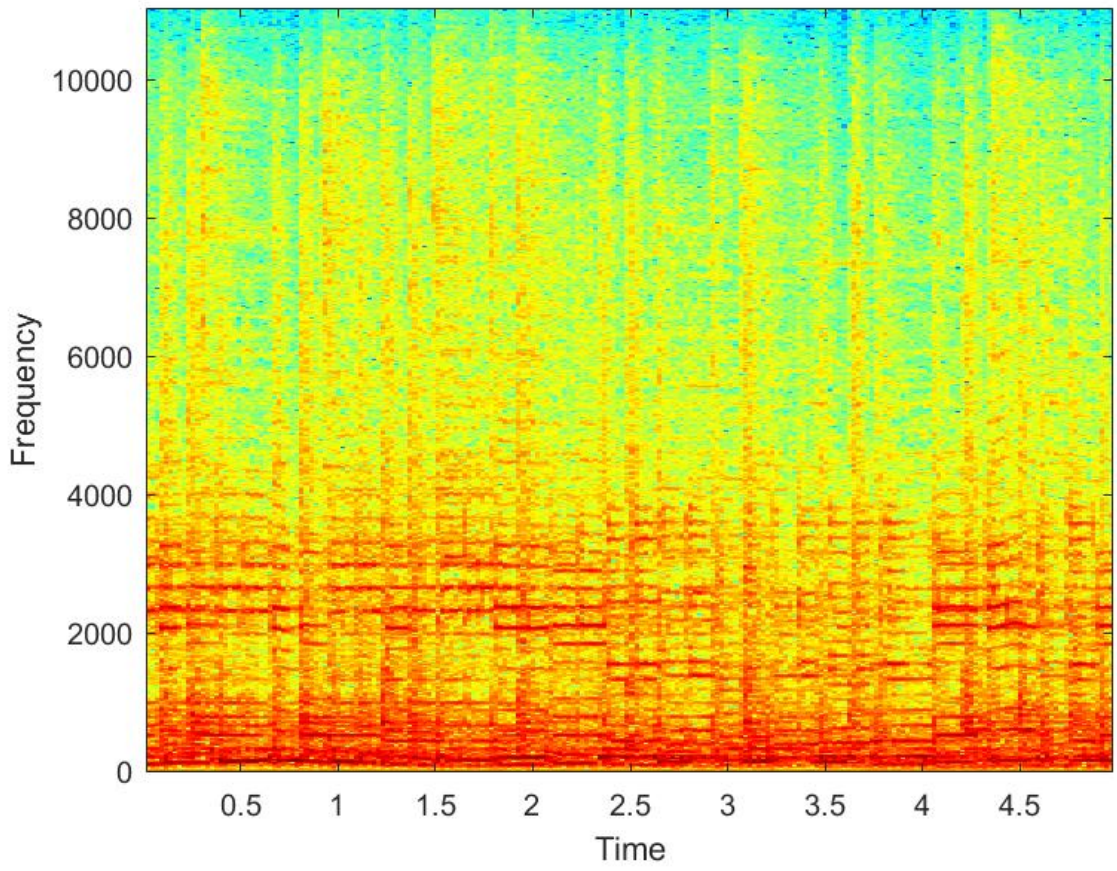

Figure 1: specgram of the input signal

2 Decimated signal - $x_d[n]$

Here, we use the decimation and interpolation functions written in the previous assignments, using a hamming window and N = 1001 samples for the low pass filter.

2.1 by factor 2

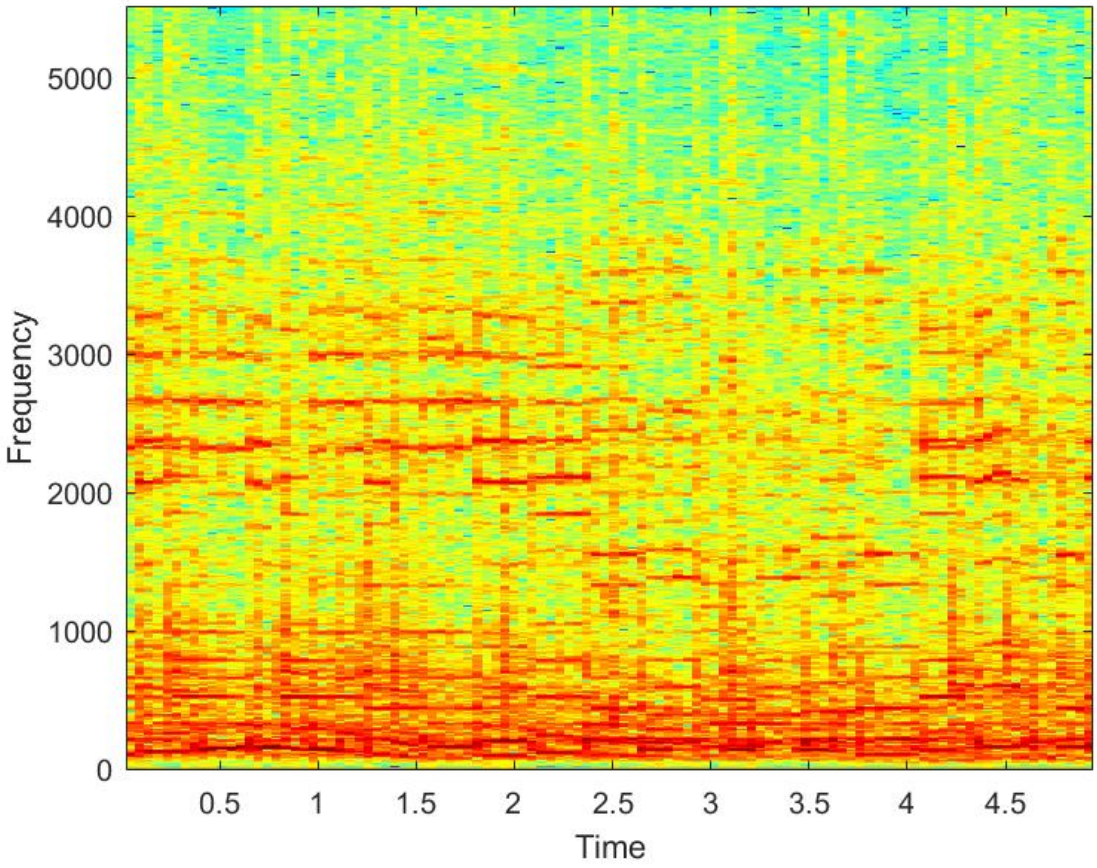

Figure 2: specgram of the signal after decimation by factor 2

- Since during decimation, we pass it through a low pass filter, we can see that the upper frequencies are cut off and the frequency range is reduced by a factor of 2.
- Therefore, while playing back this decimated version, we observe that the higher frequency sounds are missing and the sound seems to be dominated by lower frequencies when compared to the original audio.
- Also, since after decimation, the sampling rate is reduced by a factor of 2, we also observe that the clarity of the decimated signal is lower and it sounds muddy when compared to the audio of the input signal.

2.2 by factor 4

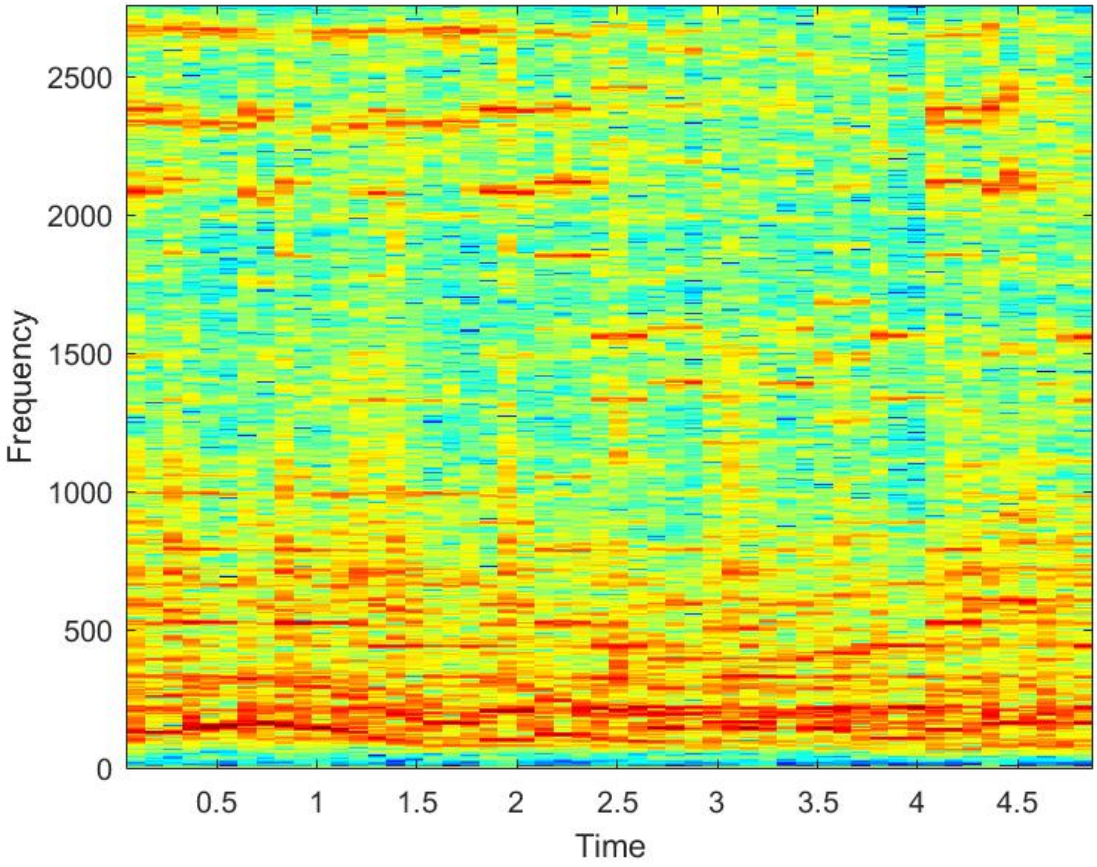

Figure 3: specgram of the signal after decimation by factor 4

- Here, we can see that the frequency range is reduced by a factor of 4.
- Therefore, even more high frequency content is lost than compared to the previous case.
- Also, since the sampling rate is reduced by a factor of 4, the clarity of this signal is also worse than the previous case.

2.3 by factor 8

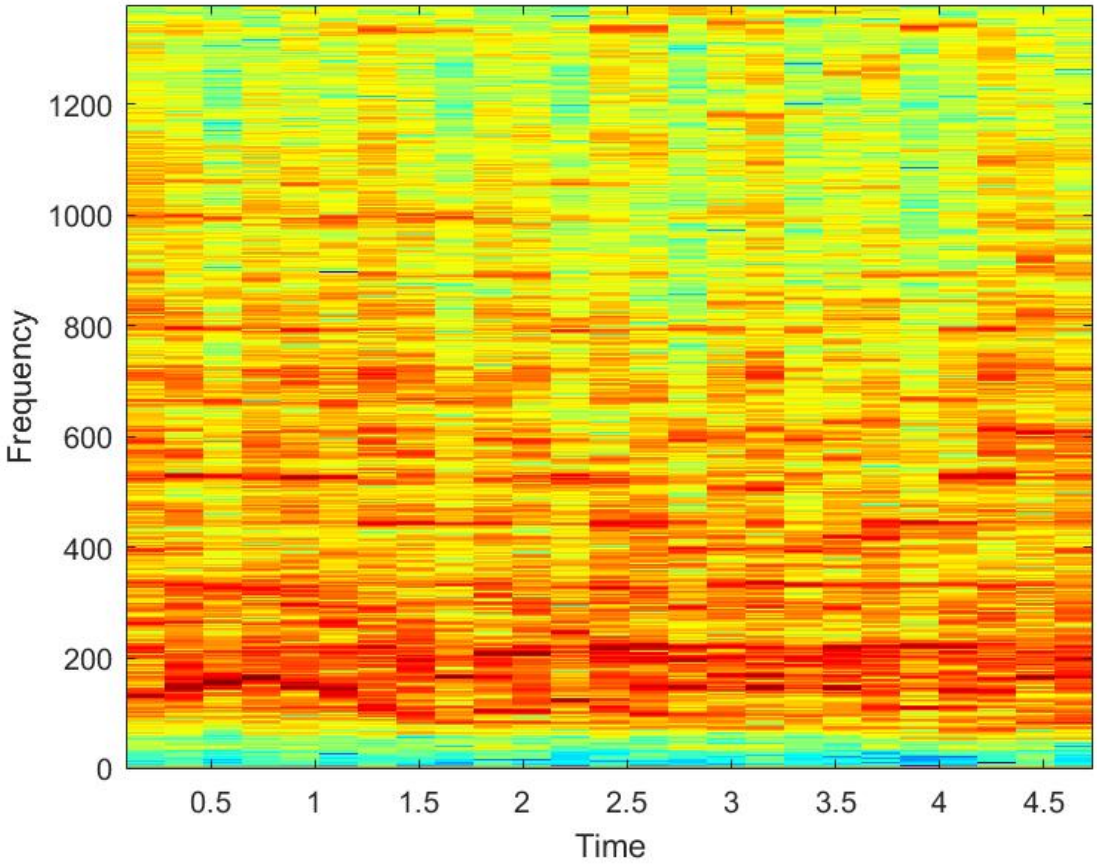

Figure 4: specgram of the signal after decimation by factor 8

- Here, we can see that the frequency range is reduced by a factor of 8.
- Therefore, even more high frequency content is lost than compared to the previous cases.
- Also, since the sampling rate is reduced by a factor of 8, the clarity of this signal is also worse than the previous cases.

3 Interpolated signal - $y[n]$

Here, we interpolate the decimated signal by the corresponding factor.

3.1 by factor 2

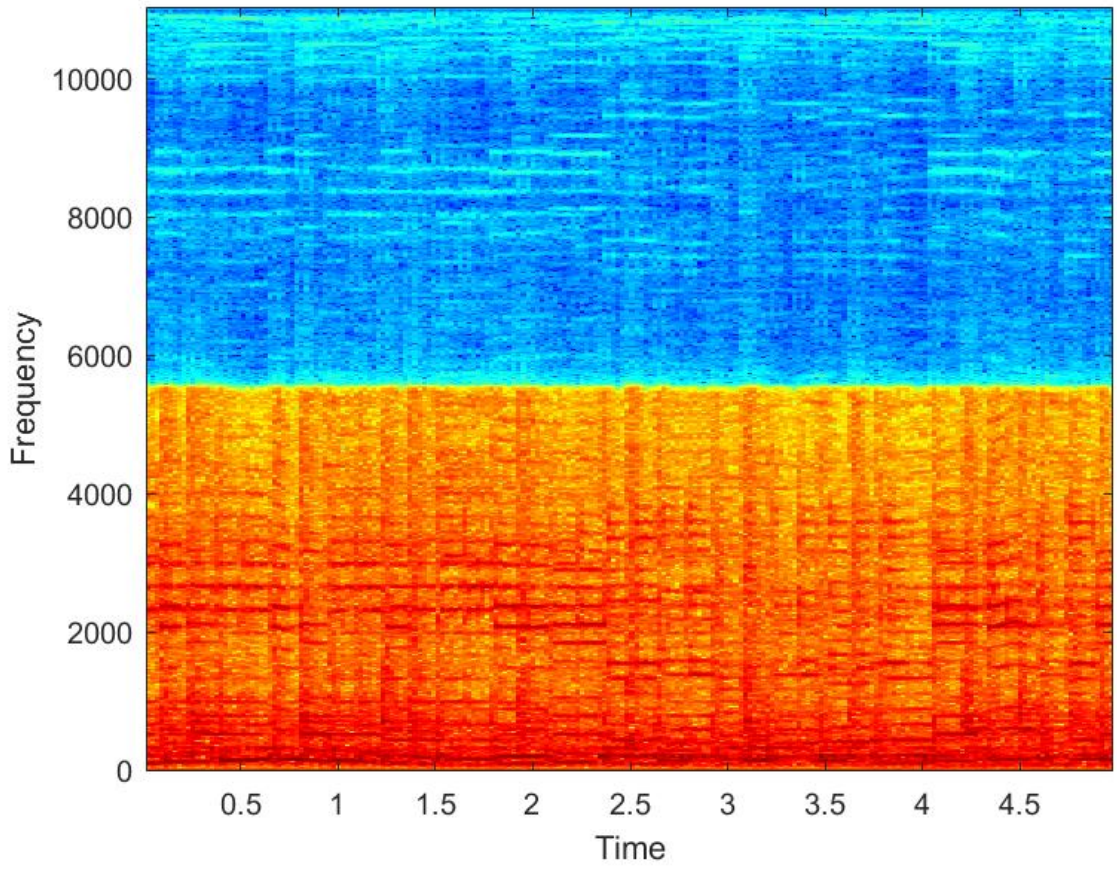

Figure 5: specgram of the signal after subsequent interpolation by factor 2

- Since interpolation cannot recover the higher frequencies that were lost during decimation, we observe that the frequency content of the interpolated signal is almost the same as that of the decimated signal.
- Also, as interpolation will add additional samples, we can observe that the original sampling rate is recovered.
- Therefore, some of the clarity that was lost during decimation is regained in this step.

3.2 by factor 4

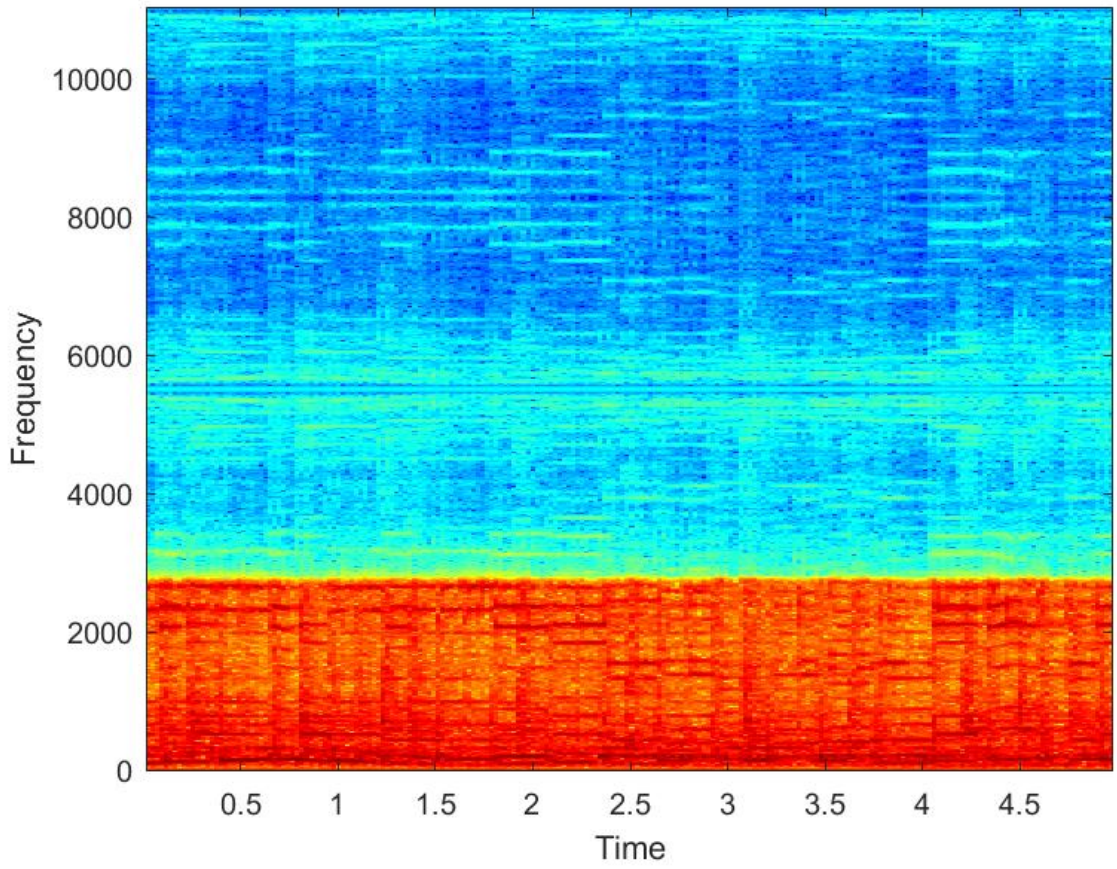

Figure 6: specgram of the signal after subsequent interpolation by factor 4

- We can see that the frequency content of this interpolated signal is the same as that of the signal decimated by a factor of 4 and that the original sampling frequency is recovered.

3.3 by factor 8

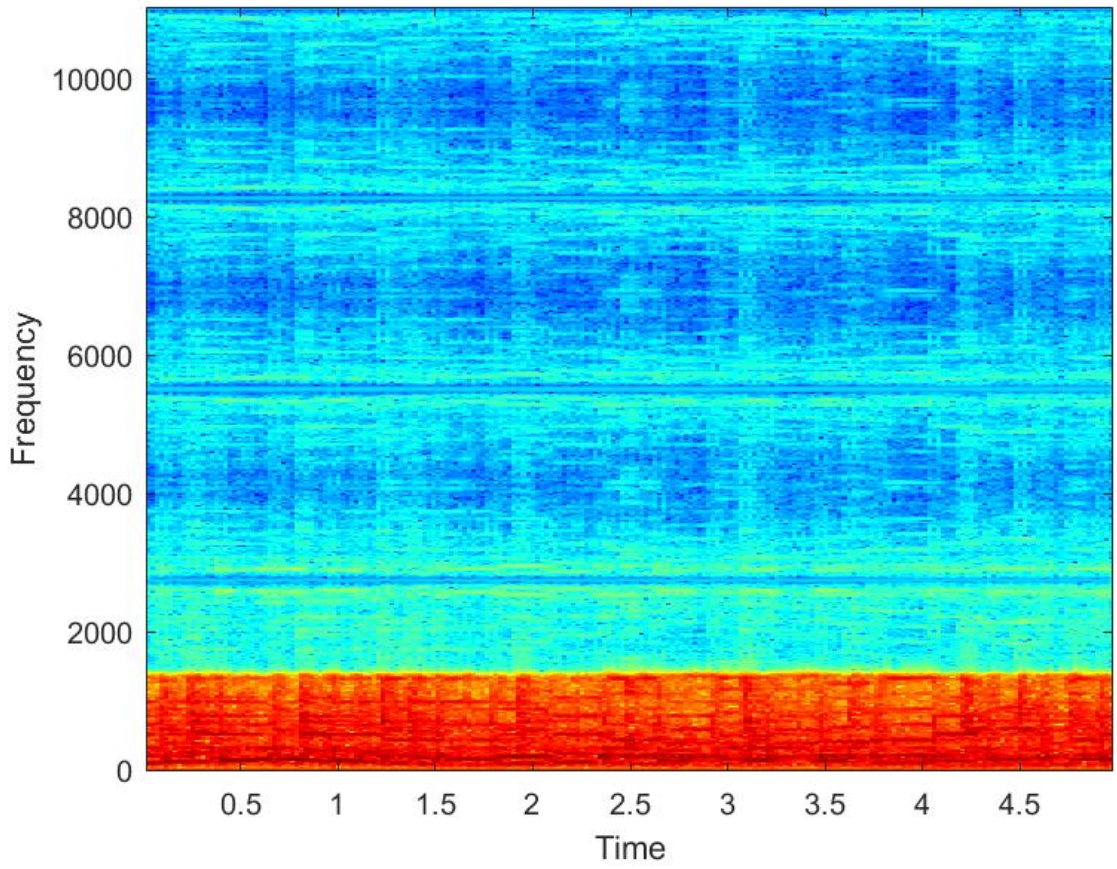

Figure 7: specgram of the signal after subsequent interpolation by factor 8

- We can see that the frequency content of this interpolated signal is the same as that of the signal decimated by a factor of 8 and that the original sampling frequency is recovered.